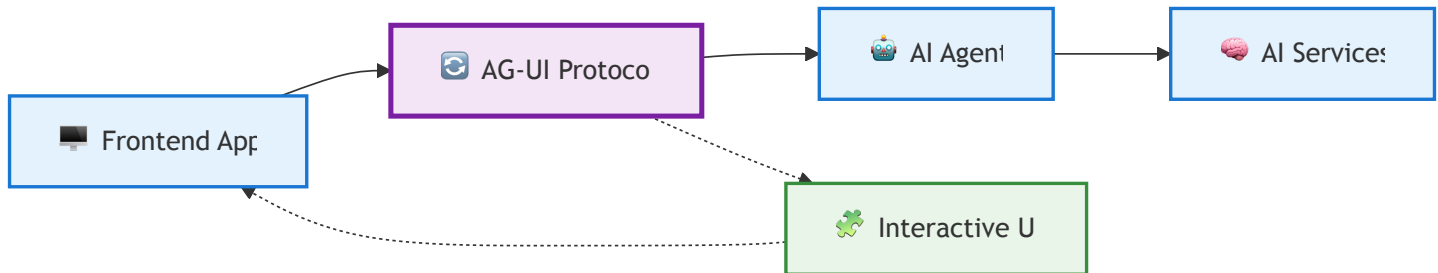


AG-UI Protocol: Building Interactive AI Agents in Frontend Applications



Tutorial Information

Last updated: June 28, 2025

Based on: AG-UI Protocol (Latest)

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Date: June 28, 2025

🚀 Why AG-UI Changes Everything for AI Frontend Development

Picture this: Sarah, a senior frontend developer at a fintech startup, spent six weeks building a custom chat interface for their AI-powered financial advisor. After months of development, she realized users needed more than just chat—they needed interactive forms, real-time data visualization, and seamless workflows. Each feature required rebuilding the entire agent integration layer from scratch.


Now imagine if there was a standardized protocol that could instantly connect any AI agent to any frontend application with interactive UI components, real-time streaming, and human-in-the-loop

workflows built in. Welcome to AG-UI—the Agent-User Interaction Protocol that transforms AI frontend development from months of custom integration to days of standardized implementation.




Why this matters now: The AI application landscape has reached a critical point where users expect more than basic chatbots. They want interactive, context-aware experiences that feel native to their applications. AG-UI solves the fragmented ecosystem where every AI framework requires its own frontend integration approach.

Think of AG-UI as the HTTP protocol for AI interactions. Just as HTTP standardized web communication, AG-UI standardizes how AI agents communicate with user interfaces, enabling a new generation of interactive AI applications.

Tutorial Overview

 **What you'll build:** A complete AI-powered project management assistant with interactive UI components, real-time collaboration, and multi-agent workflows

 **Time required:**

-  Quick Start: 25 minutes
-  Deep Dive: 90 minutes
-  Explorer Mode: Self-paced (2-4 hours)




 **Difficulty:** Intermediate (requires React/TypeScript knowledge)

 **Prerequisites:**

- Node.js 18+ and npm/yarn
- Basic React and TypeScript knowledge
- AI/LLM API access (OpenAI, Anthropic, or local model)
- Git for version control

 **Last updated:** June 28, 2025

Choose your path:

-  [Quick Start](#) (25 min) - Get a working AI agent UI immediately
-  [Deep Dive](#) (90 min) - Understand the protocol and build comprehensively
-  [Explorer Mode](#) - Interactive challenges and customizations

- 📖 [Reference Guide](#) - Quick access to code snippets and configurations

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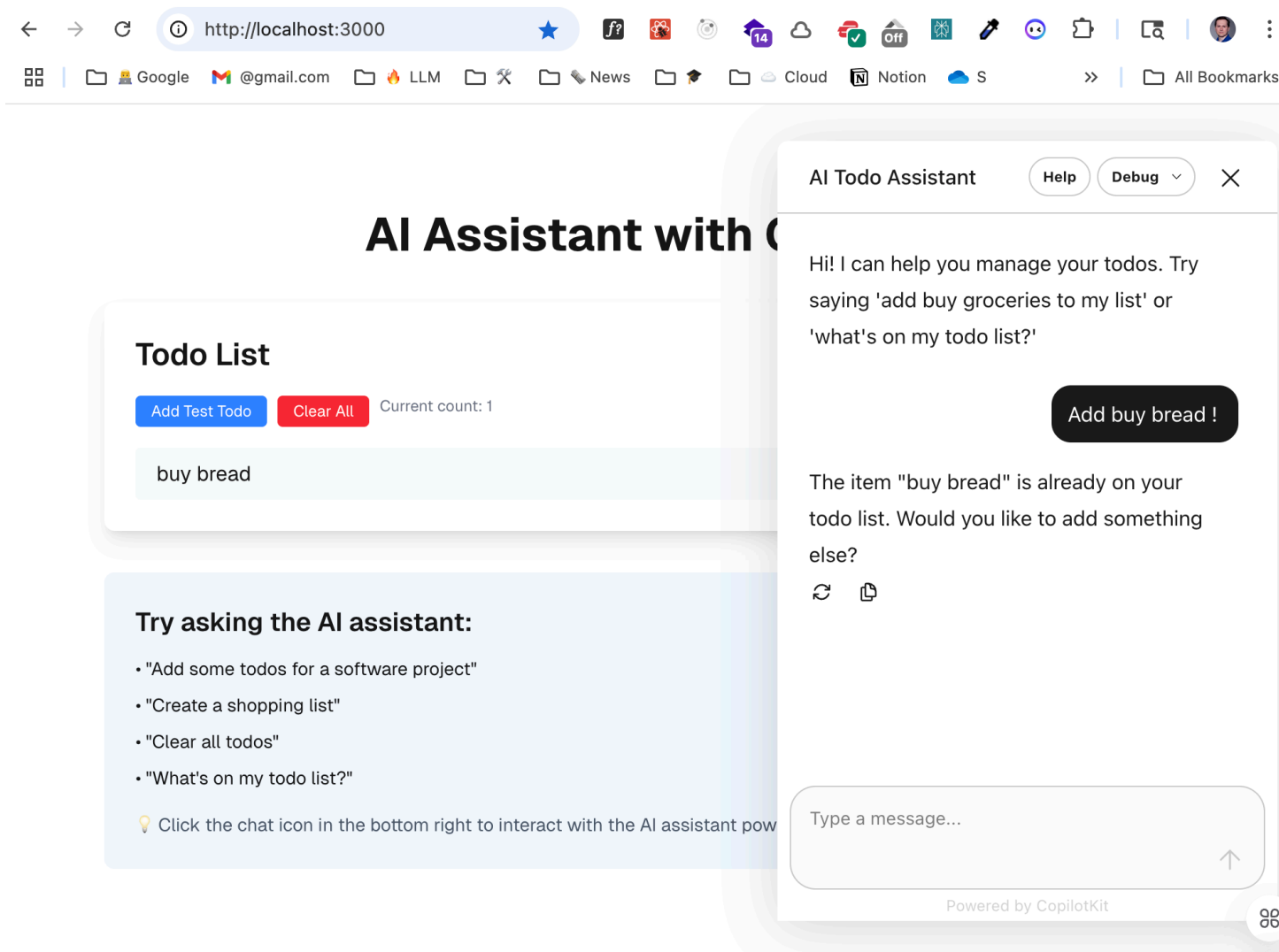
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The 30-Second Demo



← → ↻ ⓘ http://localhost:3000 ★              ⋮

☰ |  Google  @gmail.com  LLM  News  Cloud  Notion  S >> |  All Bookmarks

AI Assistant with C

Todo List

[Add Test Todo](#) [Clear All](#) Current count: 1

buy bread

Try asking the AI assistant:

- "Add some todos for a software project"
- "Create a shopping list"
- "Clear all todos"
- "What's on my todo list?"

💡 Click the chat icon in the bottom right to interact with the AI assistant power

AI Todo Assistant

[Help](#) [Debug](#) ⌵ ⌵

Hi! I can help you manage your todos. Try saying 'add buy groceries to my list' or 'what's on my todo list?'

[Add buy bread !](#)

The item "buy bread" is already on your todo list. Would you like to add something else?

↻ 📄

Type a message... ⬆

Powered by CopilotKit

💡 **Pro Tip:** Bookmark this tutorial—you'll reference the patterns and examples multiple times as you build your own AI-powered applications!

Part I: Foundation (WHY)

🔥 The AI Frontend Integration Problem

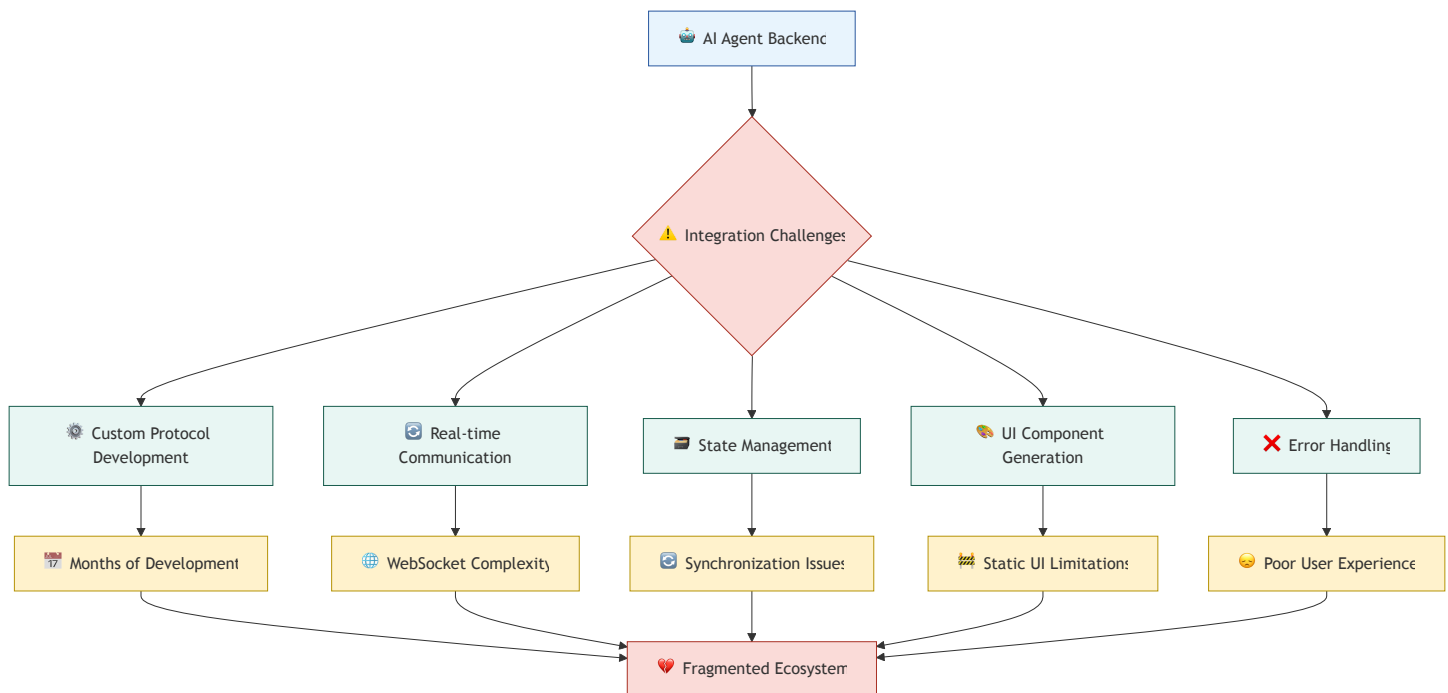
The Current Landscape

🏢 **Enterprise Reality:** Companies are spending significant resources on AI integration projects, with enterprise surveys showing that most development time is spent on frontend connectivity rather than AI logic.

📊 The Development Challenge:

- **6-12 weeks** typical time to integrate AI agent with custom UI
- **3-5 developers** typically required for a complete implementation
- **Significant project complexity** due to fragmented integration approaches
- **High enterprise costs** for AI frontend development projects

Common Pain Points

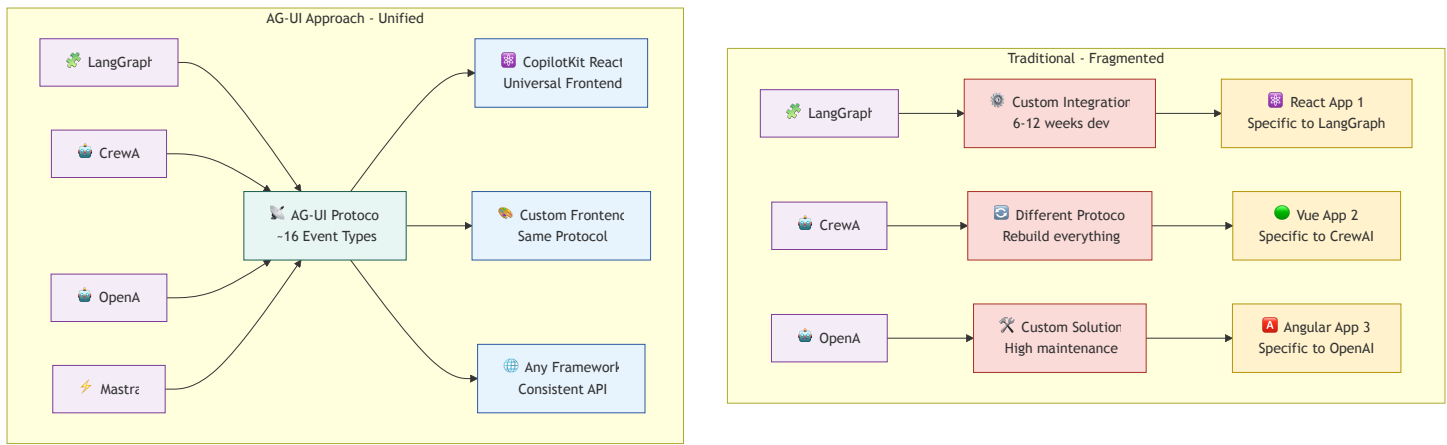


⚠️ The Fragmentation Problem:

- **LangChain** → Custom Streamlit/Gradio interfaces
- **CrewAI** → Proprietary dashboard solutions

- **OpenAI Assistants** → Limited UI customization
- **Custom Agents** → Completely bespoke implementations

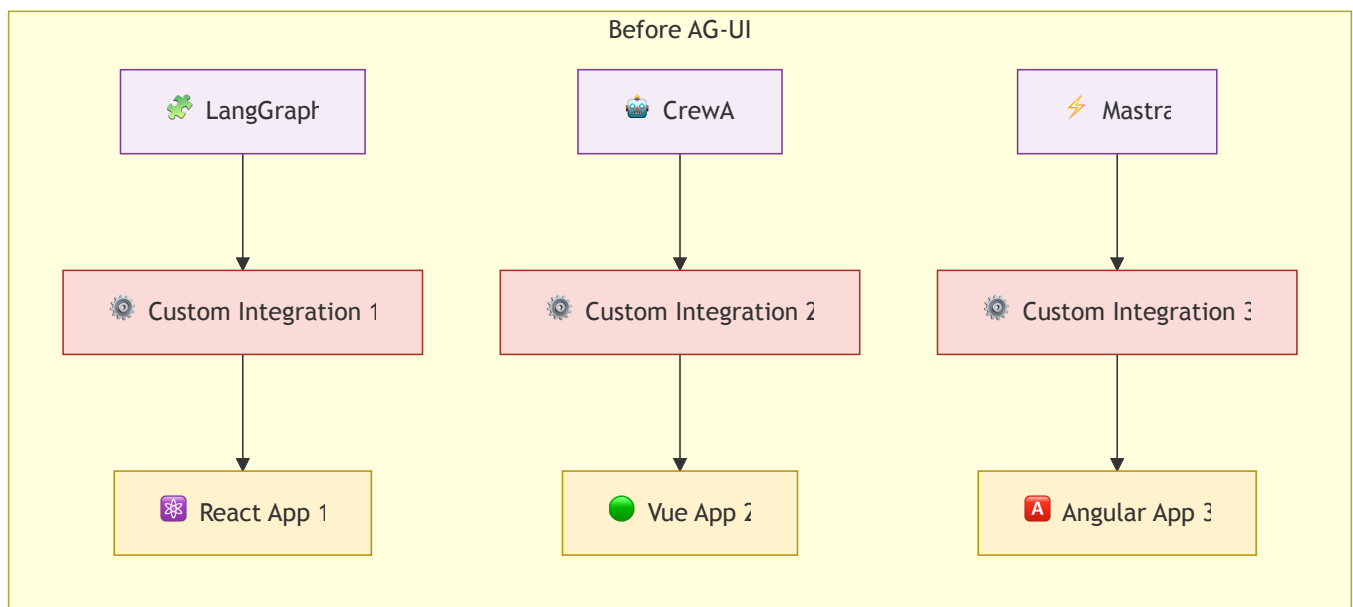
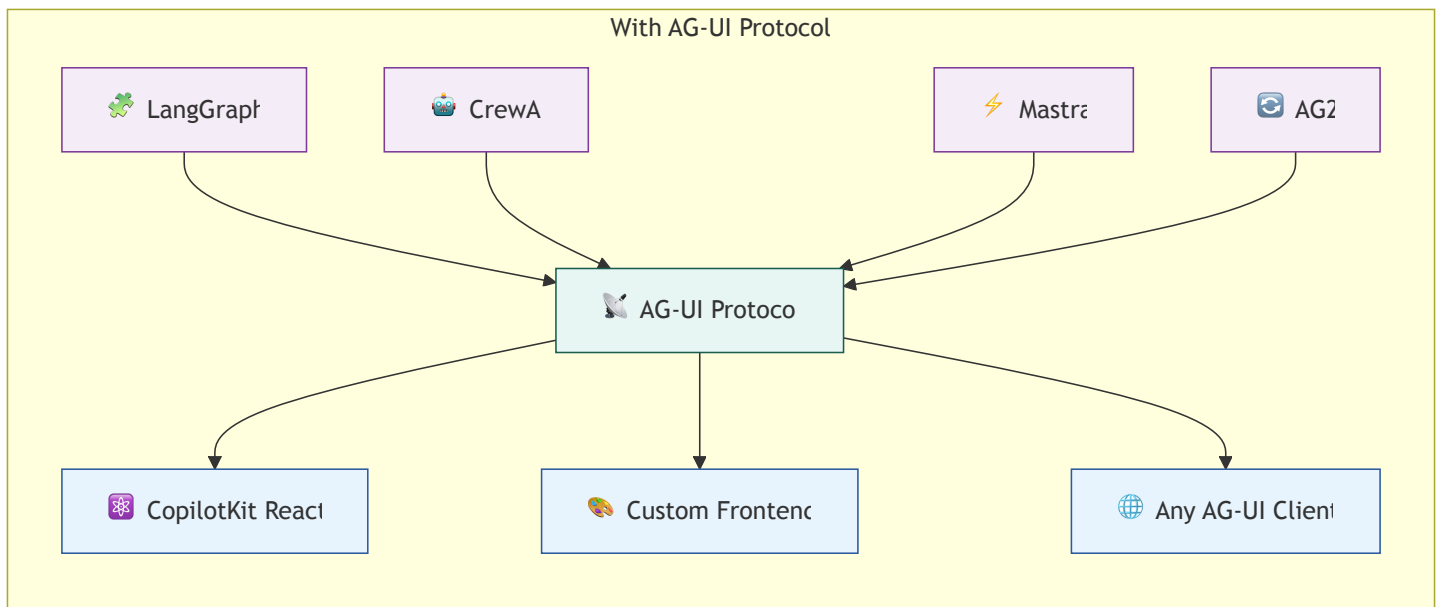
🤔 **The Result:** Every AI project becomes a full-stack development project, slowing innovation and increasing costs.



🌟 How AG-UI Solves This

The AG-UI Advantage

AG-UI transforms AI frontend development by providing a **standardized, event-driven protocol** that works with any AI framework and any frontend technology. Think of AG-UI as the HTTP protocol for AI interactions—just as HTTP standardized web communication, AG-UI standardizes how AI agents communicate with user interfaces.



✨ Key Benefits

🚀 Rapid Development:

- **Protocol standardization** reduces integration time from weeks to days
- **~16 standardized event types** for comprehensive agent-UI communication
- **One protocol** for all supported AI frameworks

🎨 Rich Interactions:

- **Event-driven streaming** with real-time UI updates
- **Bidirectional communication** between agents and interfaces

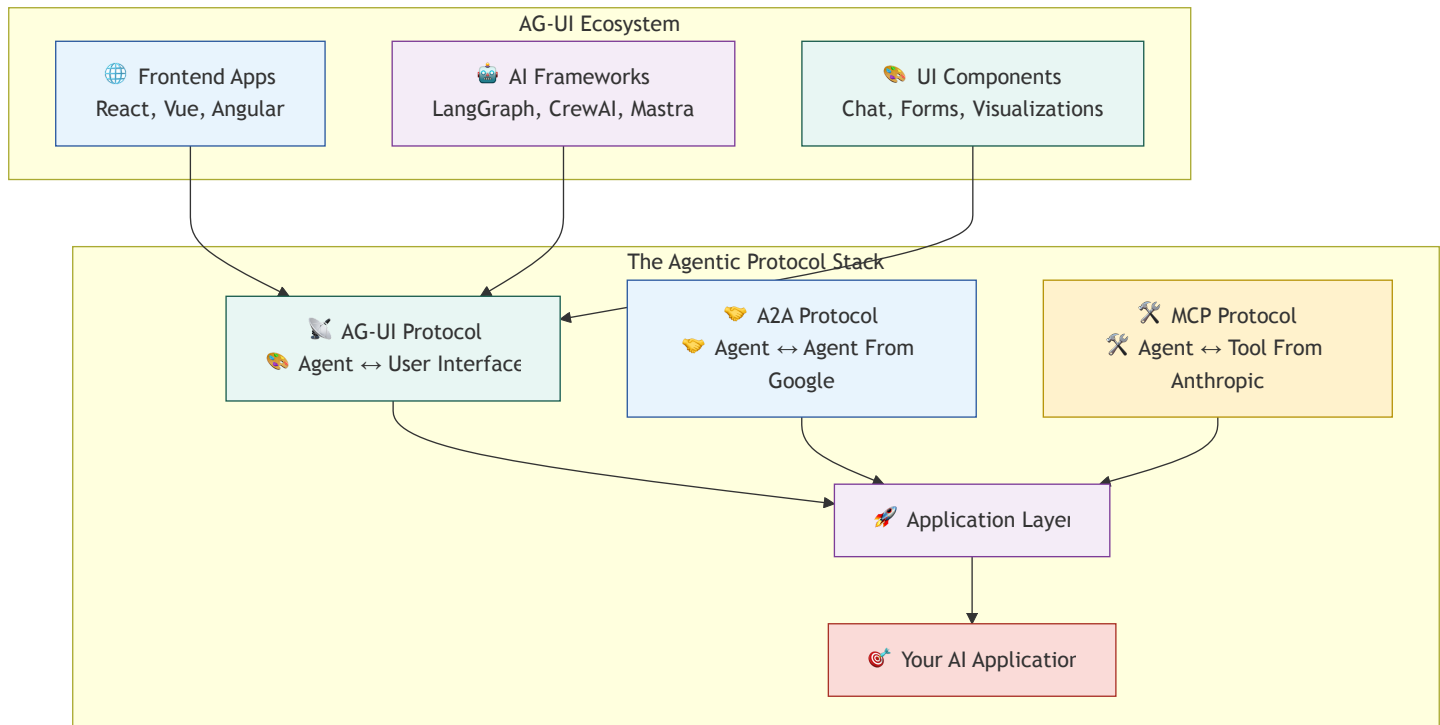
- **Tool call support** with structured responses
- **Human-in-the-loop** workflows built into the protocol

🔒 Enterprise Ready:

- **Transport agnostic** (SSE, WebSockets, HTTP, webhooks)
- **Framework integrations** for production-ready deployments
- **Open source** with MIT license and active community
- **Extensible middleware** for custom implementations

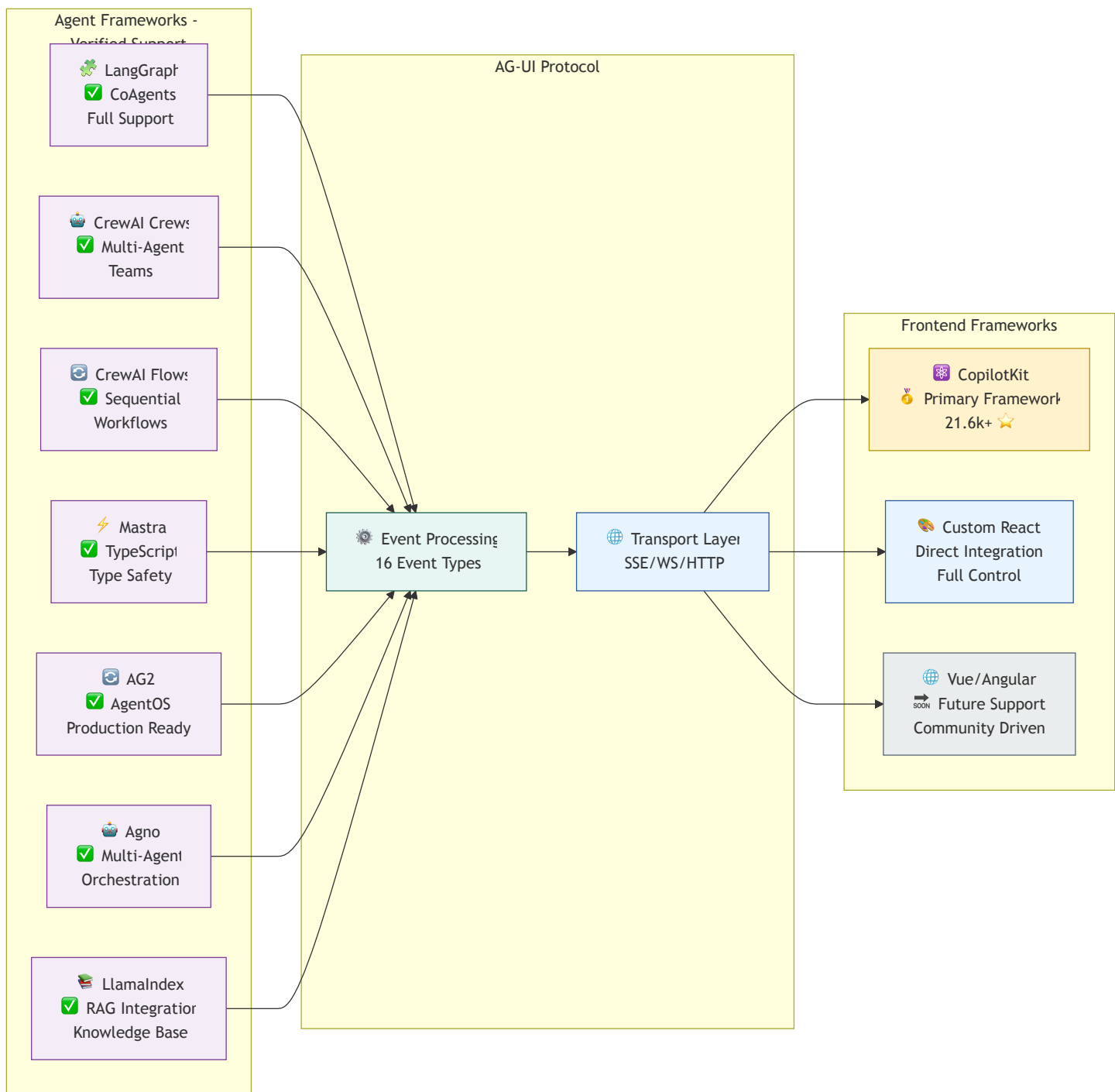
🏗️ Where AG-UI Fits in the Agentic Stack

The Three Pillars of Agentic Protocols



🔗 Complementary Protocols:

- **MCP** (Model Context Protocol) → Gives agents access to tools and data (Anthropic)
- **A2A** (Agent2Agent Protocol) → Enables multi-agent collaboration (Google Cloud, 50+ partners)
- **AG-UI** → Brings agents into user-facing applications



💡 The Power of Integration:

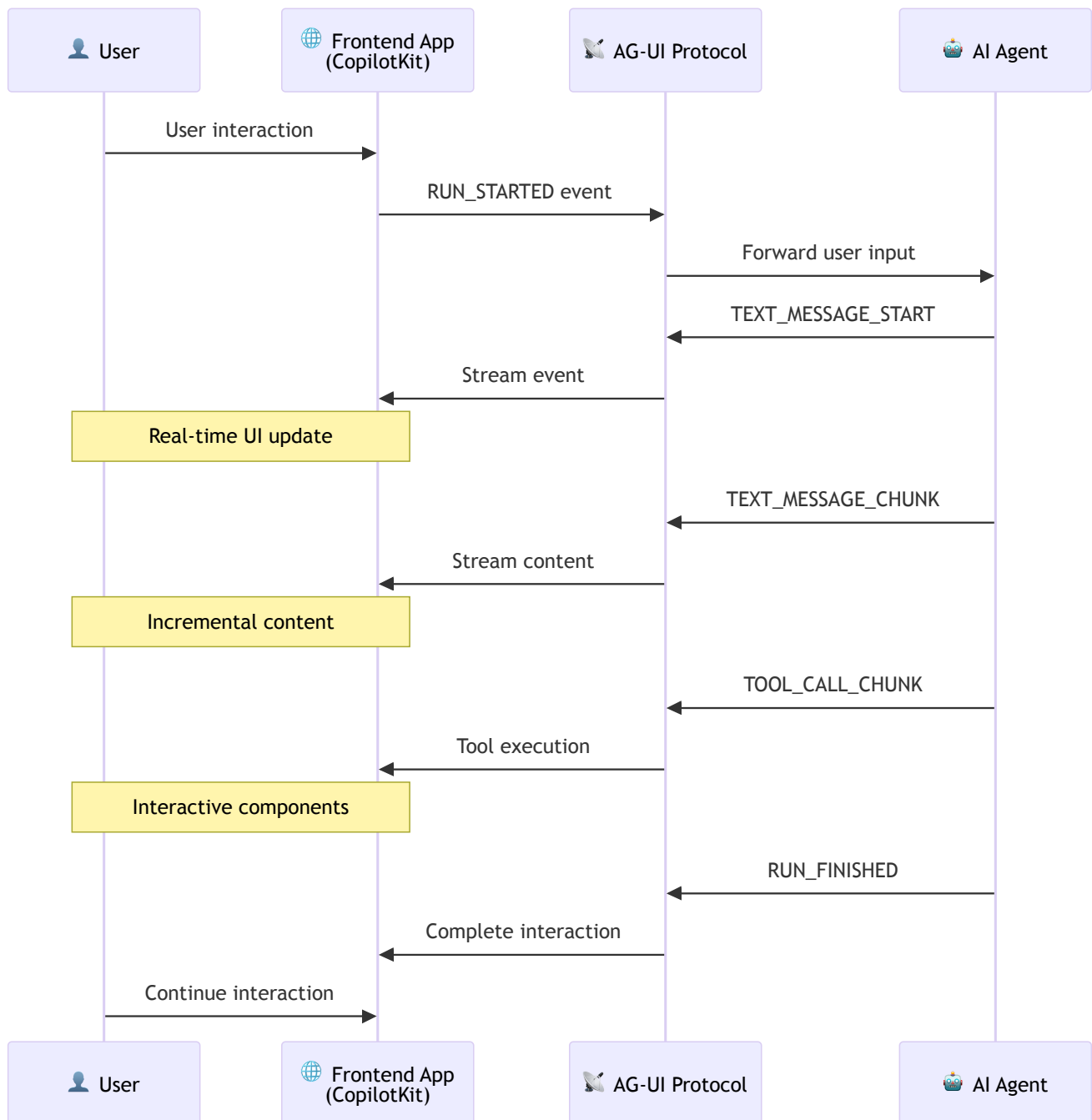
When combined, these protocols create a complete agentic ecosystem where agents can access tools (MCP), collaborate with other agents (A2A - Google's Agent2Agent protocol), and interact seamlessly with users (AG-UI).

Part II: Understanding (WHAT)


🧠 Core Concepts & Mental Models

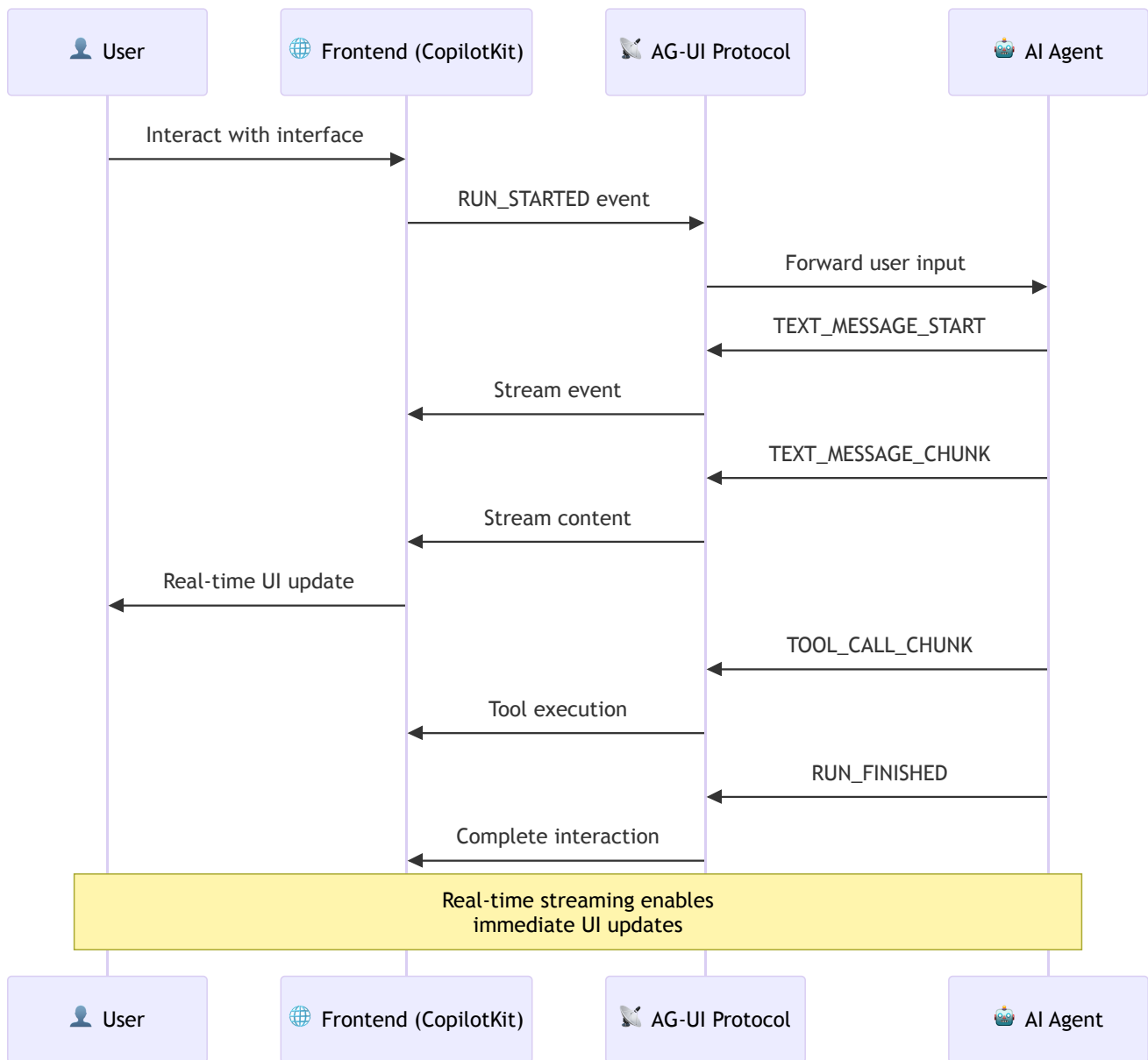
The AG-UI Mental Model

Think of AG-UI as a **conversation protocol between AI agents and user interfaces**, similar to how HTTP enables communication between web browsers and servers.



Event-Driven Communication


 **Core Principle:** Instead of request-response patterns, AG-UI uses streaming events that enable real-time, interactive experiences.



Event Types:

- **User Events** → Actions from the interface (clicks, form submissions, messages)
- **Agent Events** → Responses from AI (messages, UI updates, tool calls)
- **System Events** → Protocol management (connection, errors, state sync)


Generative UI Concept

 **Revolutionary Idea:** AI agents don't just generate text—they generate complete UI components based on context and user needs.

```
// Traditional approach
const response = await ai.chat("Show me sales data");
// Result: Text describing the sales data

// AG-UI approach
const events = await agentStream.send("Show me sales data");
// Result: Interactive chart components, filters, and actions
```

Bidirectional State Management

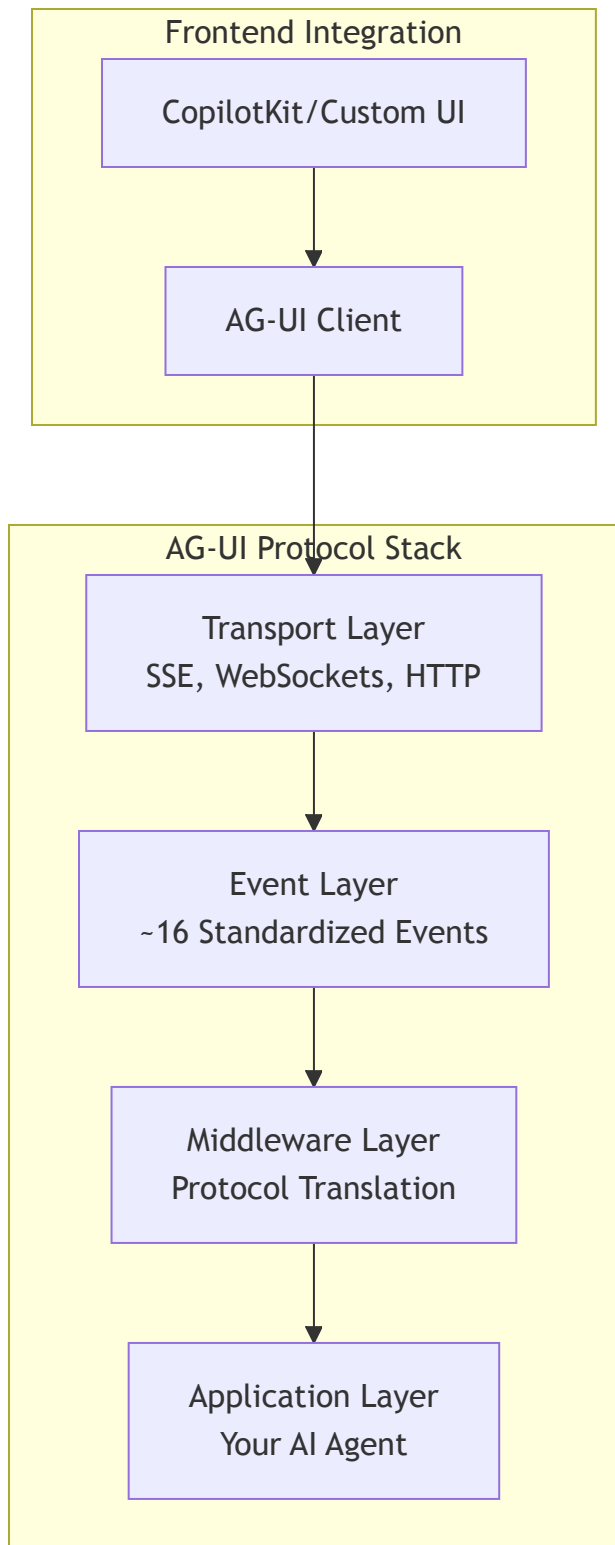
 **Key Innovation:** Unlike traditional chatbots, AG-UI maintains synchronized state between the agent and UI, enabling:

- **Context preservation** across interactions
- **Multi-step workflows** with intermediate states
- **Real-time collaboration** between users and agents
- **Undo/redo capabilities** for agent actions



The AG-UI Protocol Specification

Protocol Architecture



Core Event Types (Verified from Official Spec)

Run Lifecycle Events:

```
// Run management
RUN_STARTED; // Agent execution begins
RUN_FINISHED; // Agent execution completes
RUN_ERROR; // Error during execution
```

Message Events:

```
// Text streaming
TEXT_MESSAGE_START; // Start of message
TEXT_MESSAGE_CONTENT; // Streaming text content
TEXT_MESSAGE_END; // End of message
```

Tool & Content Events:

```
// Tool interactions
TOOL_CALL_START; // Streaming tool calls
TOOL_CALL_ARGS; // Various tool execution events

// State management
STATE_UPDATE; // Bidirectional state sync
USER_INPUT; // User interactions from UI
AGENT_RESPONSE; // Agent outputs to UI
```

Complete AG-UI Event Types Reference

All 22+ Official Event Types (from AG-UI Protocol Specification):

Event Type	Category	Direction	Description
TEXT_MESSAGE_START	Message	Agent → UI	Signals the beginning of a text message from the agent
TEXT_MESSAGE_CONTENT	Message	Agent → UI	Streams partial text content as the agent generates it

Event Type	Category	Direction	Description
TEXT_MESSAGE_END	Message	Agent → UI	Marks the completion of a text message
TEXT_MESSAGE_CHUNK	Message	Agent → UI	Chunked text message content for streaming
THINKING_TEXT_MESSAGE_START	Thinking	Agent → UI	Start of agent's thinking process text
THINKING_TEXT_MESSAGE_CONTENT	Thinking	Agent → UI	Content of agent's thinking process
THINKING_TEXT_MESSAGE_END	Thinking	Agent → UI	End of agent's thinking process
TOOL_CALL_START	Tool	Agent → UI	Indicates an agent is about to execute a tool/action
TOOL_CALL_ARGS	Tool	Agent → UI	Streams the arguments being passed to a tool
TOOL_CALL_END	Tool	Agent → UI	Signals that tool execution has completed
TOOL_CALL_CHUNK	Tool	Agent → UI	Chunked tool call data for streaming
TOOL_CALL_RESULT	Tool	Agent → UI	Delivers the result of tool execution
THINKING_START	Thinking	Agent → UI	Agent starts thinking/reasoning process
THINKING_END	Thinking	Agent → UI	Agent completes thinking/reasoning process
STATE_SNAPSHOT	State	Agent → UI	Complete snapshot of agent state
STATE_DELTA	State	Agent → UI	Incremental updates to agent state (JSON Patch)

Event Type	Category	Direction	Description
MESSAGES_SNAPSHOT	State	Agent → UI	Complete snapshot of conversation messages
RAW	System	Bidirectional	Raw event passthrough for external systems
CUSTOM	System	Bidirectional	Custom application-specific events
RUN_STARTED	Lifecycle	Agent → UI	Agent run/session has begun
RUN_FINISHED	Lifecycle	Agent → UI	Agent run/session has completed successfully
RUN_ERROR	Lifecycle	Agent → UI	Agent run/session has encountered an error
STEP_STARTED	Workflow	Agent → UI	A workflow step has started execution
STEP_FINISHED	Workflow	Agent → UI	A workflow step has completed execution

Event Categories:

- **Message Events** (4) → Text streaming and conversation flow
- **Thinking Events** (5) → Agent reasoning and internal processes
- **Tool Events** (5) → Function calls and agent actions
- **Lifecycle Events** (3) → Run management and completion status
- **State Events** (3) → Agent state and message synchronization
- **System Events** (2) → Protocol management and custom functionality
- **Workflow Events** (2) → Step-by-step process control

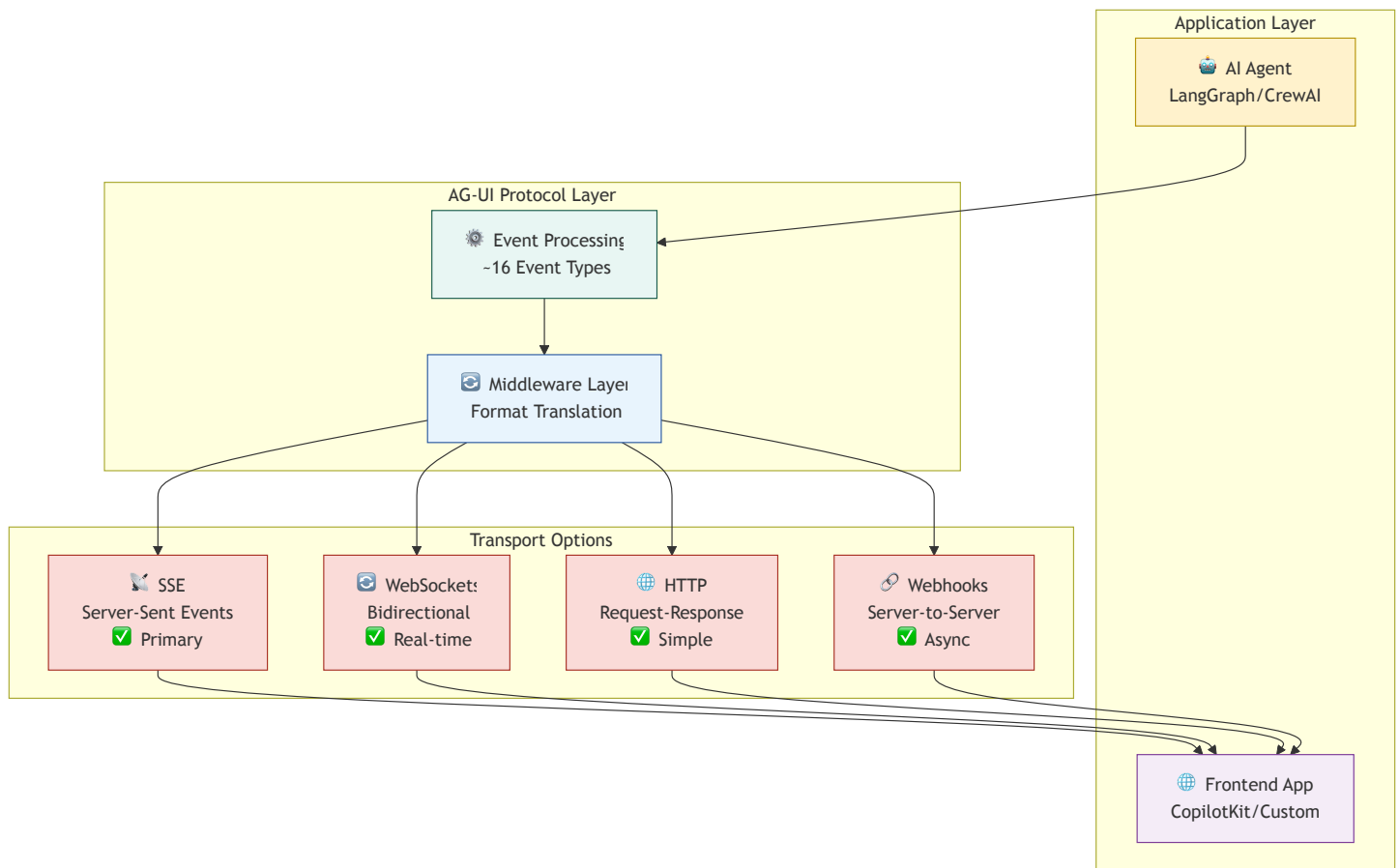
Usage Patterns:

- **Streaming Text:** TEXT_MESSAGE_START → TEXT_MESSAGE_CONTENT (multiple) → TEXT_MESSAGE_END
- **Tool Execution:** TOOL_CALL_START → TOOL_CALL_ARGS → TOOL_CALL_END → TOOL_CALL_RESULT
- **Session Management:** RUN_STARTED → [work events] → RUN_FINISHED / RUN_ERROR

- **Real-time Updates:** STATE_SNAPSHOT / STATE_DELTA for continuous state sync

🔧 Transport Flexibility (Production Verified)

📡 Supported Transports:



🎯 Transport Selection Guide:

- **Server-Sent Events (SSE)** → Primary choice for streaming, simple and reliable
- **WebSockets** → Best for bidirectional, low-latency real-time communication
- **HTTP** → Traditional request-response for simple interactions
- **Webhooks** → Server-to-server event delivery for async workflows

Part III: Implementation (HOW)

Building an AI-Powered Todo App with CopilotKit and OpenAI

A complete step-by-step tutorial for creating an intelligent todo application that understands natural language and can manage tasks through AI conversation.

What You'll Build

By the end of this tutorial, you'll have:

- A modern todo application with a beautiful UI
- AI assistant that can add, remove, and manage todos through natural conversation
- Persistent storage using localStorage
- Full integration with OpenAI's GPT models
- Real-time AI interaction using CopilotKit

Prerequisites

- Node.js 18+ installed
- Basic knowledge of React and TypeScript
- An OpenAI API key (get one at platform.openai.com)

Step 1: Project Setup

1.1 Create a New Next.js Project

```
npm create-next-app@latest my-ai-assistant --typescript --tailwind --eslint --app --src
cd my-ai-assistant
```

1.2 Install CopilotKit Dependencies

```
npm install @copilotkit/react-core @copilotkit/react-ui @copilotkit/runtime @langchain/
```

1.3 Set Up Environment Variables

Create a `.env` file in your project root:

```
# AI Provider – Using OpenAI (recommended for tool calling support)
OPENAI_API_KEY=your_openai_api_key_here
OPENAI_MODEL=gpt-4o-mini

# Optional: CopilotKit Cloud (if using hosted service)
# COPILOTKIT_API_KEY=your_copilotkit_api_key
```

⚠ **Important:** Replace `your_openai_api_key_here` with your actual OpenAI API key.



Step 2: Configure the Backend API

2.1 Create the CopilotKit API Route

Create `src/app/api/copilotkit/route.ts`:

```

import {
  CopilotRuntime,
  OpenAIAdapter,
  copilotRuntimeNextJSAppRouterEndpoint,
} from "@copilotkit/runtime";
import { NextRequest } from "next/server";

// Create OpenAI adapter – supports tool calling
const serviceAdapter = new OpenAIAdapter({
  model: process.env.OPENAI_MODEL || "gpt-4o-mini",
});

// Create the CopilotRuntime
const runtime = new CopilotRuntime();

// POST handler for CopilotKit runtime
export const POST = async (req: NextRequest) => {
  const { handleRequest } = copilotRuntimeNextJSAppRouterEndpoint({
    runtime,
    serviceAdapter,
    endpoint: "/api/copilotkit",
  });

  return handleRequest(req);
};

```

Step 3: Create the CopilotKit Provider

3.1 Create the Provider Component

Create `src/components/CopilotProvider.tsx` :

```
"use client";

import { CopilotKit } from "@copilotkit/react-core";
import "@copilotkit/react-ui/styles.css";

interface CopilotProviderProps {
  children: React.ReactNode;
}

export function CopilotProvider({ children }: CopilotProviderProps) {
  return <CopilotKit runtimeUrl="/api/copilotkit">{children}</CopilotKit>;
}
```

3.2 Update the Root Layout

Update `src/app/layout.tsx` :

```

import type { Metadata } from "next";
import { Geist, Geist_Mono } from "next/font/google";
import "./globals.css";
import { CopilotProvider } from "@components/CopilotProvider";

const geistSans = Geist({
  variable: "--font-geist-sans",
  subsets: ["latin"],
});

const geistMono = Geist_Mono({
  variable: "--font-geist-mono",
  subsets: ["latin"],
});

export const metadata: Metadata = {
  title: "AI Todo Assistant",
  description: "AG-UI powered todo app with CopilotKit and OpenAI",
};

export default function RootLayout({
  children,
}: Readonly<{
  children: React.ReactNode;
}>) {
  return (
    <html lang="en" suppressHydrationWarning>
      <body
        className={` ${geistSans.variable} ${geistMono.variable} antialiased` }
        suppressHydrationWarning
      >
        <CopilotProvider>{children}</CopilotProvider>
      </body>
    </html>
  );
}

```



Step 4: Build the Main Todo Component

4.1 Create the Main Page

Replace the content of `src/app/page.tsx` :

```

"use client";

import { useCopilotAction, useCopilotReadable } from "@copilotkit/react-core";
import { CopilotPopup } from "@copilotkit/react-ui";
import { useState, useRef, useEffect } from "react";

export default function Home() {
  // Initialize state with localStorage data
  const [todoList, setTodoList] = useState<string[]>(() => {
    if (typeof window !== "undefined") {
      const saved = localStorage.getItem("ag-ui-todos");
      return saved ? JSON.parse(saved) : [];
    }
    return [];
  });
  const todoListRef = useRef(todoList);

  // Keep ref in sync with state and persist to localStorage
  useEffect(() => {
    todoListRef.current = todoList;
    // Persist to localStorage
    if (typeof window !== "undefined") {
      localStorage.setItem("ag-ui-todos", JSON.stringify(todoList));
    }
  }, [todoList]);

  // Make the todo list readable by the AI
  useCopilotReadable({
    description: "The current todo list with all todo items",
    value:
      todoList.length === 0
        ? "No todos currently in the list"
        : `Current todos: ${todoList.join(", ")}`,
  });

  // Allow AI to add todos
  useCopilotAction({
    name: "add_todo",
    description: "Add a new todo item to the list",
    parameters: [
      {
        name: "todo",
        type: "string",
      },
    ],
  });

```



```

        description: "The todo item to add",
        required: true,
    },
],
handler: async ({ todo }) => {
    console.log("🚀 ADD_TODO HANDLER CALLED with:", todo);
    console.log("🚀 Current todoList from ref:", todoListRef.current);
    setTodoList((prevList) => {
        console.log("🚀 Previous state in setter:", prevList);
        const newList = [...prevList, todo];
        console.log("🚀 New state will be:", newList);
        return newList;
    });
},
});

// Allow AI to clear todos
useCopilotAction({
    name: "clear_todos",
    description: "Clear all todo items from the list",
    handler: async () => {
        console.log("🧹 CLEAR_TODOS HANDLER CALLED");
        setTodoList([]);
        // Also clear from localStorage
        if (typeof window !== "undefined") {
            localStorage.removeItem("ag-ui-todos");
        }
    },
});

return (
    <div className="min-h-screen p-8 pb-20 gap-16 sm:p-20 font-[family-name:var(--font-
    <main className="max-w-4xl mx-auto">
        <h1 className="text-4xl font-bold mb-8 text-center">
            AI Assistant with OpenAI
        </h1>
        <div className="bg-white dark:bg-gray-800 rounded-lg shadow-lg p-6 mb-8">
            <h2 className="text-2xl font-semibold mb-4">Todo List</h2>
            <div className="mb-4 flex gap-2">
                <button
                    onClick={() => setTodoList((prev) => [...prev, "Test todo"])}
                    className="px-3 py-1 bg-blue-500 text-white rounded text-xs"
                >

```

```

        Add Test Todo
      </button>
      <button
        onClick={() => {
          setTodoList([]);
          if (typeof window !== "undefined") {
            localStorage.removeItem("ag-ui-todos");
          }
        }}
        className="px-3 py-1 bg-red-500 text-white rounded text-xs"
      >
        Clear All
      </button>
      <span className="text-xs text-gray-500">
        Current count: {todoList.length}
      </span>
    </div>
    {todoList.length === 0 ? (
      <div className="text-gray-500 italic">
        No todos yet. Ask the AI assistant to add some!
      </div>
    ) : (
      <ul className="space-y-2">
        {todoList.map((todo, index) => (
          <li
            key={index}
            className="flex items-center p-2 bg-gray-50 dark:bg-gray-700 rounded"
          >
            <span className="ml-2">{todo}</span>
          </li>
        ))}
      </ul>
    )}
  </div>

<div className="bg-blue-50 dark:bg-blue-900/30 rounded-lg p-6">
  <h3 className="text-xl font-semibold mb-3">
    Try asking the AI assistant:
  </h3>
  <ul className="space-y-2 text-sm">
    <li>• "Add some todos for a software project"</li>
    <li>• "Create a shopping list"</li>
    <li>• "Clear all todos"</li>
  </ul>

```

```

        <li>• "What's on my todo list?"</li>
      </ul>
      <div className="mt-4 text-sm text-gray-600 dark:text-gray-400">
        💡 Click the chat icon in the bottom right to interact with the AI
        assistant powered by OpenAI
      </div>
    </div>
  </main>

  <CopilotPopup
    instructions="You are a helpful AI assistant that can help users manage their t
    labels={{
      title: "AI Todo Assistant",
      initial:
        "Hi! I can help you manage your todos. Try saying 'add buy groceries to my
    }}
  />
</div>
);
}

```

Step 5: Understanding Key CopilotKit Concepts

5.1 useCopilotReadable Hook

This hook makes data accessible to the AI:

```

useCopilotReadable({
  description: "The current todo list with all todo items",
  value:
    todoList.length === 0
      ? "No todos currently in the list"
      : `Current todos: ${todoList.join(", ")}`,
});

```


Purpose: Allows the AI to "see" the current state of your todo list and respond accurately to questions like "What's on my list?"

5.2 useCopilotAction Hook

This hook defines actions the AI can perform:

```
useCopilotAction({
  name: "add_todo",
  description: "Add a new todo item to the list",
  parameters: [
    {
      name: "todo",
      type: "string",
      description: "The todo item to add",
      required: true,
    },
  ],
  handler: async ({ todo }) => {
    setTodoList((prevList) => [...prevList, todo]);
  },
});
```

Purpose: Enables the AI to execute functions in your app when users make requests like "Add buy milk to my list"

 **Debug Tip:** The console.log statements help you debug and track when AI actions are triggered. You can see these logs in your browser's developer console.

5.3 CopilotPopup Component

Provides the chat interface:

```
<CopilotPopup
  instructions="You are a helpful AI assistant..."
  labels={{
    title: "AI Todo Assistant",
    initial: "Hi! I can help you manage your todos...",
  }}
/>
```



Step 6: Run and Test Your Application

6.1 Start the Development Server

```
npm run dev
```

6.2 Test the Application

1. Open <http://localhost:3001> in your browser (Note: Next.js may use port 3001 if 3000 is busy)
2. Click the chat icon in the bottom right corner
3. Try these commands:
 - "Add buy groceries to my list"
 - "Create a todo for calling mom"
 - "What's on my todo list?"
 - "Clear all my todos"



Step 7: Advanced Features (Optional Enhancements)

7.1 Add Todo Removal Functionality

Add this action to your component:

```

useCopilotAction({
  name: "remove_todo",
  description: "Remove a specific todo item from the list",
  parameters: [
    {
      name: "todoIndex",
      type: "number",
      description: "The index of the todo item to remove (0-based)",
      required: true,
    },
  ],
  handler: async ({ todoIndex }) => {
    setTodoList((prevList) =>
      prevList.filter((_, index) => index !== todoIndex)
    );
  },
});

```

7.2 Add Priority Levels

Extend your todo items to include priorities:

```

interface TodoItem {
  id: string;
  text: string;
  priority: "low" | "medium" | "high";
  completed: boolean;
}

```

7.3 Add Due Dates

Include date functionality:

```

interface TodoItem {
  id: string;
  text: string;
  dueDate?: Date;
  completed: boolean;
}

```



Step 8: Troubleshooting Common Issues

Issue 1: "Tool calling not supported"

Solution: Make sure you're using OpenAI models (not Ollama) as they have better tool calling support.

Issue 2: API Key Not Working

Solution:

- Verify your OpenAI API key is correct
- Make sure it's in `.env` (or `.env.local`)
- Restart your development server after adding the key

Issue 3: AI Not Responding

Solution:

- Check browser console for errors
- Verify the `/api/copilotkit` route is working
- Ensure you have sufficient OpenAI API credits



Key Learning Points

CopilotKit Architecture

1. **Frontend:** React hooks (`useCopilotAction` , `useCopilotReadable`) define what AI can see and do
2. **Backend:** API route handles communication with OpenAI
3. **Provider:** Wraps your app to enable CopilotKit functionality





Best Practices

1. **Clear Descriptions:** Write detailed descriptions for actions and readable data
2. **Error Handling:** Always handle async operations properly
3. **State Management:** Use refs for actions that need current state
4. **Persistence:** Save important data to `localStorage` or a database



Congratulations

You've built a fully functional AI-powered todo application! The AI can now:

-  Read your current todos
-  Add new todos through natural language
-  Clear all todos when requested
-  Understand context and respond intelligently



Next Steps

- Deploy your app to Vercel or Netlify
- Add user authentication
- Connect to a real database (PostgreSQL, MongoDB)
- Add more complex AI actions
- Implement todo categories and tags
- Add voice input functionality



Additional Resources

- [CopilotKit Documentation](#)
- [OpenAI API Reference](#)
- [Next.js Documentation](#)
- [Tailwind CSS Documentation](#)

Happy coding! 🎯 You now have the foundation to build sophisticated AI-powered applications with CopilotKit.



Deep Dive

Understanding the Architecture



AG-UI Application Structure:


```
my-ai-assistant/  
├── src/  
│   ├── agents/           # AI agent definitions  
│   ├── components/       # UI components  
│   ├── lib/              # AG-UI configuration  
│   └── pages/            # App pages  
├── public/  
└── package.json
```

Building Advanced Interactions

Real-Time Data Visualization

 **Scenario:** Create an agent that generates dynamic charts based on live data.

```

import { useCopilotAction, useCopilotReadable } from "@copilotkit/react-core";
import { useState, useEffect } from "react";
import { BarChart, LineChart, PieChart } from "recharts";

interface ChartData {
  id: string;
  type: "bar" | "line" | "pie";
  data: Array<{ name: string; value: number; [key: string]: any }>;
  title: string;
  config: {
    xAxisKey: string;
    yAxisKey: string;
    colorScheme: string[];
  };
}

export const DataVisualizationAgent = () => {
  const [charts, setCharts] = useState<ChartData[]>([]);
  const [liveData, setLiveData] = useState<any[]>([]);

  // Simulate live data updates
  useEffect(() => {
    const interval = setInterval(() => {
      setLiveData((prev) => [
        ...prev.slice(-50), // Keep last 50 data points
        {
          timestamp: new Date().toISOString(),
          sales: Math.floor(Math.random() * 1000) + 500,
          users: Math.floor(Math.random() * 200) + 100,
          revenue: Math.floor(Math.random() * 5000) + 2000,
        },
      ]);
    }, 2000);

    return () => clearInterval(interval);
  }, []);

  // Make live data available to agent
  useCopilotReadable({
    description:
      "Live business metrics data including sales, users, and revenue",
    value: {
      currentData: liveData.slice(-10),
    },
  });
}

```

```

        totalDataPoints: liveData.length,
    },
});

// Action to create charts from data
useCopilotAction({
    name: "create_data_visualization",
    description:
        "Create an interactive chart from the live data or provided dataset",
    parameters: [
        {
            name: "chartType",
            type: "string",
            description: "Type of chart: 'bar', 'line', or 'pie'",
            required: true,
        },
        {
            name: "title",
            type: "string",
            description: "Title for the chart",
            required: true,
        },
        {
            name: "xAxisKey",
            type: "string",
            description: "Key for X-axis data (e.g., 'timestamp', 'name')",
            required: true,
        },
        {
            name: "yAxisKey",
            type: "string",
            description: "Key for Y-axis data (e.g., 'sales', 'users', 'revenue')",
            required: true,
        },
        {
            name: "dataSource",
            type: "string",
            description:
                "Data source: 'live' for live data or 'custom' for provided data",
            required: false,
        },
    ],
    handler: async ({

```

```

    chartType,
    title,
    xAxisKey,
    yAxisKey,
    dataSource = "live",
  }) => {
    const chartData: ChartData = {
      id: `chart-${Date.now()}`,
      type: chartType as "bar" | "line" | "pie",
      title,
      data: dataSource === "live" ? liveData.slice(-20) : [],
      config: {
        xAxisKey,
        yAxisKey,
        colorScheme: ["#8884d8", "#82ca9d", "#ffc658", "#ff7c7c"],
      },
    };

    setCharts((prev) => [...prev, chartData]);
    return `Created ${chartType} chart "${title}" with ${chartData.data.length} data
  },
});

// Action to analyze trends
useCopilotAction({
  name: "analyze_data_trends",
  description: "Analyze trends in the live data and provide insights",
  parameters: [
    {
      name: "metric",
      type: "string",
      description: "Metric to analyze: 'sales', 'users', or 'revenue'",
      required: true,
    },
    {
      name: "timeframe",
      type: "number",
      description: "Number of recent data points to analyze",
      required: false,
    },
  ],
  handler: async ({ metric, timeframe = 10 }) => {
    if (liveData.length < timeframe) {

```

```

    return "Not enough data points for analysis";
  }

  const recentData = liveData.slice(-timeframe);
  const values = recentData
    .map((d) => d[metric])
    .filter((v) => typeof v === "number");

  if (values.length === 0) {
    return `No valid data found for metric: ${metric}`;
  }

  const average = values.reduce((a, b) => a + b, 0) / values.length;
  const trend =
    values[values.length - 1] > values[0] ? "increasing" : "decreasing";
  const change = (
    ((values[values.length - 1] - values[0]) / values[0]) *
    100
  ).toFixed(2);

  return `Analysis for ${metric}: Average: ${average.toFixed(
    2
  )}, Trend: ${trend}, Change: ${change}%`;
},
});

const renderChart = (chart: ChartData) => {
  const commonProps = {
    width: 400,
    height: 300,
    data: chart.data,
  };

  switch (chart.type) {
    case "bar":
      return <BarChart {...commonProps} />;
    case "line":
      return <LineChart {...commonProps} />;
    case "pie":
      return <PieChart {...commonProps} />;
    default:
      return <div>Unsupported chart type</div>;
  }
}

```

```

};

return (
  <div className="data-visualization-agent">
    <h3>Data Visualization Agent</h3>

    <div className="live-metrics">
      <h4>Live Metrics ({liveData.length} data points)</h4>
      {liveData.slice(-1).map((data, index) => (
        <div key={index} className="metric-display">
          <span>Sales: {data.sales}</span>
          <span>Users: {data.users}</span>
          <span>Revenue: ${data.revenue}</span>
        </div>
      ))}
    </div>

    <div className="charts-grid">
      {charts.map((chart) => (
        <div key={chart.id} className="chart-container">
          <h4>{chart.title}</h4>
          {renderChart(chart)}
          <button
            onClick={() =>
              setCharts((prev) => prev.filter((c) => c.id !== chart.id))
            }
          >
            Remove Chart
          </button>
        </div>
      ))}
    </div>

    {charts.length === 0 && (
      <p>Ask me to create visualizations from the live data!</p>
    )}
  </div>
);
};

```

🎯 **Test it:** Try prompts like:

- "Create a line chart showing sales trends over time"

- "Analyze the revenue trends in the last 15 data points"
- "Make a bar chart comparing all three metrics"

Real-Time Collaboration

👉 Human-in-the-Loop Workflows:

```
export const collaborativeAgent = new AgentBuilder()
  .withName("Collaborative Assistant")
  .withTools([
    {
      name: "request_approval",
      description: "Request human approval for actions",
      parameters: {
        type: "object",
        properties: {
          action: { type: "string" },
          reason: { type: "string" },
          options: { type: "array", items: { type: "string" } },
        },
      },
      handler: async (params) => ({
        type: "ui_component",
        component: {
          type: "approval_request",
          props: {
            message: `I'd like to ${params.action}. ${params.reason}`,
            options: params.options,
            onApprove: "execute_action",
            onReject: "suggest_alternatives",
          },
        },
      }),
    },
  ])
  .build();
```

Custom UI Components

🎨 Building Your Own Components:

```
// src/components/CustomChart.tsx
import { AgentUIComponent } from "@ag-ui/react";

interface ChartProps {
  data: Array<{ name: string; value: number }>;
  type: "bar" | "line" | "pie";
}

export const CustomChart: AgentUIComponent<ChartProps> = (props) => {
  return (
    <div className="agent-chart">
      <h3>Data Visualization</h3>
      { /* Your custom chart implementation */ }
      <YourChartLibrary data={props.data} type={props.type} />
    </div>
  );
};

// Register the component
AgentUI.registerComponent("custom_chart", CustomChart);
```

State Management Patterns

 **Advanced State Synchronization:**


```
import { useAgentState } from "@ag-ui/react";

export const ProjectDashboard = () => {
  const [projectState, updateProjectState] = useAgentState("project");

  // State automatically syncs with agent
  const handleTaskUpdate = (taskId: string, updates: Partial<Task>) => {
    updateProjectState({
      type: "UPDATE_TASK",
      payload: { taskId, updates },
    });
  };

  return (
    <div>
      <h2>{projectState.name}</h2>
      <TaskList tasks={projectState.tasks} onUpdate={handleTaskUpdate} />
    </div>
  );
};
```

Explorer Mode

Challenge 1: Multi-Agent Workflow

Build a Customer Support System

Create a system with multiple specialized agents:

- **Triage Agent** → Categorizes incoming requests
- **Technical Agent** → Handles technical issues
- **Billing Agent** → Manages billing inquiries
- **Escalation Agent** → Handles complex cases

Hints:

- Use agent delegation patterns
- Implement handoff protocols
- Create specialized UI components for each agent type

Challenge 2: Real-Time Analytics Dashboard

Build a Live Data Dashboard

Create an agent that:

- Connects to real-time data sources
- Generates interactive charts and graphs
- Provides natural language insights
- Allows users to drill down into data

Starter Code:


```
export const analyticsAgent = new AgentBuilder()  
  .withName("Analytics Assistant")  
  .withTools([  
    "connect_to_database",  
    "generate_chart",  
    "provide_insights",  
    "create_drill_down",  
  ])  
  .build();
```

Challenge 3: AI-Powered Form Builder

Build Dynamic Form Generation

Create an agent that:

- Generates forms based on natural language descriptions
- Validates input in real-time
- Provides intelligent suggestions
- Handles complex form logic

 **Bonus:** Make it work with existing backend APIs

Part IV: Advanced Topics



Security & Authentication

Authentication Patterns



OAuth 2.0 Integration:

```
import { AgentBuilder, AuthProvider } from "@ag-ui/core";

const authProvider = new AuthProvider({
  type: "oauth2",
  clientId: process.env.OAUTH_CLIENT_ID,
  redirectUri: process.env.OAUTH_REDIRECT_URI,
  scopes: ["read", "write", "admin"],
});

export const secureAgent = new AgentBuilder()
  .withAuth(authProvider)
  .withSystemPrompt("You are a secure assistant with access to user data.")
  .build();
```

Data Protection



Input Sanitization:

```
import { sanitizeInput, validateSchema } from "@ag-ui/security";

const safeToolHandler = async (params: any) => {
  // Sanitize all inputs
  const sanitized = sanitizeInput(params);

  // Validate against schema
  const isValid = validateSchema(sanitized, parameterSchema);
  if (!isValid) {
    throw new Error("Invalid parameters");
  }

  // Proceed with safe execution
  return handleTool(sanitized);
};
```

Performance & Optimization

Streaming Optimization

Efficient Event Streaming:

```
export const optimizedAgent = new AgentBuilder()
  .withStreamingConfig({
    batchSize: 10, // Batch events for efficiency
    flushInterval: 100, // Flush every 100ms
    compression: "gzip", // Compress event streams
    maxConcurrent: 5, // Limit concurrent streams
  })
  .build();
```

Caching Strategies

Intelligent Caching:

```
import { CacheProvider } from "@ag-ui/cache";

const cache = new CacheProvider({
  type: "redis",
  ttl: 3600, // 1 hour
  keyPrefix: "agui:agent:",
});

export const cachedAgent = new AgentBuilder()
  .withCache(cache)
  .withCacheStrategy("smart") // Cache based on content similarity
  .build();
```

Multi-Agent Orchestration

Agent Delegation

Coordinated Multi-Agent Systems:

```
export const orchestratorAgent = new AgentBuilder()
  .withName("Orchestrator")
  .withAgents([
    { name: "researcher", agent: researchAgent },
    { name: "analyst", agent: analysisAgent },
    { name: "writer", agent: writingAgent },
  ])
  .withOrchestrationStrategy("pipeline")
  .build();
```

Workflow Management

Complex Workflow Patterns:

```
const workflowConfig = {
  steps: [
    { agent: "researcher", output: "research_data" },
    { agent: "analyst", input: "research_data", output: "insights" },
    { agent: "writer", input: "insights", output: "final_report" },
  ],
  errorHandling: "retry",
  maxRetries: 3,
};
```

Part V: Reference & Resources

Troubleshooting Guide

Common Issues and Solutions

Agent not responding:

```
# Check agent health
curl http://localhost:3000/api/health

# Verify API keys
echo $OPENAI_API_KEY | cut -c1-10

# Check logs
npm run logs
```

UI components not rendering:

```
// Verify component registration
import { AgentUI } from "@ag-ui/react";
console.log(AgentUI.getRegisteredComponents());

// Check component props
const isValidProps = AgentUI.validateProps("todo_list", props);
```

❌ WebSocket connection issues:

```
// Use fallback transport
const config = {
  transport: {
    primary: "websocket",
    fallback: "sse",
  },
};
```

Performance Troubleshooting

🐌 Slow agent responses:

- Check model response times
- Optimize tool implementations
- Use streaming for long operations
- Implement caching for repeated queries

🐌 UI performance issues:

- Implement virtual scrolling for large datasets
- Use React.memo for expensive components
- Optimize event handling
- Reduce unnecessary re-renders

📖 Framework Integration Guides

LangGraph Integration (CoAgents)

🔗 Resources:

- [LangGraph Documentation](#)
- [CopilotKit CoAgents Guide](#)
- [LangGraph + CopilotKit Examples](#)

```
import { useCoAgent } from "@copilotkit/react-core";

// LangGraph agent with AG-UI protocol support
export const LangGraphExample = () => {
  const { agentState } = useCoAgent({
    name: "travel_planner",
    initialState: {
      destination: "",
      budget: 0,
      preferences: [],
    },
  });

  return (
    <div>
      <h2>Travel Planning Agent</h2>
      <p>Destination: {agentState.destination}</p>
      <p>Budget: ${agentState.budget}</p>
    </div>
  );
};
```

CrewAI Integration

Resources:

- [CrewAI Documentation](#)
- [CrewAI Crews Guide](#)
- [CrewAI Flows Guide](#)
- [AG-UI Integration](#)


```
import { useCopilotAction } from "@copilotkit/react-core";

// CrewAI multi-agent workflow with AG-UI
export const CrewAIExample = () => {
  useCopilotAction({
    name: "research_and_write",
    description: "Research topic and write article using CrewAI",
    parameters: [
      { name: "topic", type: "string", description: "Research topic" },
    ],
    handler: async ({ topic }) => {
      // Triggers CrewAI workflow through AG-UI events
      return `Starting research on ${topic} with researcher and writer agents`;
    },
  });

  return <div>CrewAI Research Assistant</div>;
};
```

Mastra Integration

Resources:

- [Mastra Documentation](#)
- [AG-UI Integration Guide](#)
- [GitHub Repository](#)

```
import { AbstractAgent, RunAgentInput, BaseEvent } from "@ag-ui/client";
import { Observable } from "rxjs";

// Mastra TypeScript agent with AG–UI protocol
export class MastraAgent extends AbstractAgent {
  protected run(input: RunAgentInput): Observable<BaseEvent> {
    return new Observable((observer) => {
      // Emit AG–UI events from Mastra workflow
      observer.next({
        type: "RUN_STARTED",
        threadId: input.threadId,
        runId: input.runId,
      });

      // Process with Mastra and stream results
      // ...
    });
  }
}
```

AG2 Integration

Resources:

- [AG2 Documentation](#)
- [GitHub Repository](#)
- [AG-UI Integration](#)

```
import { AG2Agent } from "@ag2/core";
import { AGUIAdapter } from "@ag-ui/ag2-adapter";

// AG2 agent with AG-UI integration
export const AG2Example = () => {
  const agent = new AG2Agent({
    name: "coordinator",
    systemMessage: "You coordinate multiple agents",
  });

  const aguiAdapter = new AGUIAdapter(agent);

  return aguiAdapter.createReactComponent();
};
```

Agno Integration

Resources:

- [Agno Documentation](#)
- [GitHub Repository](#)
- [Examples](#)

```
import { AgnoWorkflow } from "@agno/core";

// Agno multi-agent system with AG-UI
export const AgnoExample = () => {
  const workflow = new AgnoWorkflow({
    agents: [
      { name: "planner", role: "planning" },
      { name: "executor", role: "execution" },
      { name: "reviewer", role: "review" },
    ],
  });

  return workflow.createAGUIInterface();
};
```

LlamaIndex Integration

Resources:

- [LlamaIndex Documentation](#)
- [GitHub Repository](#)
- [AG-UI RAG Examples](#)

```
import { VectorStoreIndex, Document } from "llamaindex";
import { useCopilotAction } from "@copilotkit/react-core";

// LlamaIndex RAG with AG-UI
export const LlamaIndexExample = () => {
  useCopilotAction({
    name: "search_knowledge_base",
    description: "Search the knowledge base using LlamaIndex",
    parameters: [
      { name: "query", type: "string", description: "Search query" },
    ],
    handler: async ({ query }) => {
      const index = await VectorStoreIndex.fromDocuments(documents);
      const queryEngine = index.asQueryEngine();
      const response = await queryEngine.query(query);
      return response.toString();
    },
  });

  return <div>Knowledge Base Assistant</div>;
};
```

Community & Resources

Official Resources

- 📖 **Documentation:** <https://docs.ag-ui.com>
- 🎮 **AG-UI Dojo (Interactive Examples):** <https://copilotkit-feature-viewer.vercel.app>
- 💬 **Discord Community:** <https://discord.gg/6dffbvGU3D>
- 🌟 **Main Repository:** <https://github.com/ag-ui-protocol/ag-ui>

CopilotKit Resources (Primary Frontend Implementation)

- 📖 **CopilotKit Docs:** <https://docs.copilotkit.ai>
- 🎥 **Examples & Demos:** <https://github.com/CopilotKit/CopilotKit/tree/main/examples>

- 🌟 **CopilotKit Repository:** <https://github.com/CopilotKit/CopilotKit> (21.6k+ stars)

Community Contributions

- 🌟 **Example Projects:** [GitHub Examples](#)
- 💬 **GitHub Discussions:** [AG-UI Protocol Discussions](#)
- 🔗 **Integration Examples:** Multiple framework integrations in main repo
- 📝 **Specification Discussions:** [Specification Repository](#)

Getting Help

Support Channels:

1. **GitHub Issues** → [Bug reports and feature requests](#)
2. **Discord** → Real-time community support and discussions
3. **GitHub Discussions** → Technical questions and protocol discussions
4. **CopilotKit Support** → Frontend implementation questions

API Reference

Core Classes

AgentBuilder

```
class AgentBuilder {  
  withName(name: string): AgentBuilder;  
  withDescription(description: string): AgentBuilder;  
  withSystemPrompt(prompt: string): AgentBuilder;  
  withTools(tools: Tool[]): AgentBuilder;  
  withAuth(auth: AuthProvider): AgentBuilder;  
  withConfig(config: AgentConfig): AgentBuilder;  
  build(): Agent;  
}
```

AgentUI Components

```
interface AgentUIComponent<T = any> {  
  (props: T): JSX.Element;  
  displayName?: string;  
  propTypes?: Record<string, any>;  
}
```

```
// Built-in components
```

```
"chat" |  
  "form" |  
  "table" |  
  "chart" |  
  "kanban" |  
  "timeline" |  
  "approval_request" |  
  "todo_list";
```

Event Types

```
interface MessageEvent {  
  type: "message";  
  content: string;  
  role: "user" | "agent";  
  timestamp: number;  
  metadata?: Record<string, any>;  
}
```

```
interface UIEvent {  
  type: "ui_component";  
  component: {  
    type: string;  
    props: Record<string, any>;  
    actions?: Action[];  
  };  
}
```

```
interface StateEvent {  
  type: "state_update";  
  patch: JsonPatch[];  
  version: number;  
}
```

What's Next?

Advanced Learning Paths

Intermediate Developer (You are here!)

- ☐ Build multi-agent systems
- ☐ Implement custom UI components
- ☐ Add real-time collaboration features
- ☐ Optimize for production deployment

Advanced Developer

- ☐ Contribute to AG-UI protocol development

- ☐ Build framework integrations
- ☐ Create enterprise-grade solutions
- ☐ Mentor other developers

🌟 AG-UI Expert

- ☐ Speak at conferences about AG-UI
- ☐ Write technical blog posts
- ☐ Lead open-source contributions
- ☐ Build commercial AG-UI products

Upcoming Features

🗺️ AG-UI Roadmap:

- **Voice Interactions** → Natural speech integration
- **Mobile SDKs** → Native iOS/Android support
- **Visual Agent Builder** → Drag-and-drop agent creation
- **Enterprise Dashboard** → Analytics and monitoring
- **Marketplace** → Share and discover agents

Join the Community

👉 How to Contribute:

1. **Star the Repository** → [ag-ui-protocol/ag-ui](https://github.com/ag-ui-protocol/ag-ui)
2. **Join Discord** → Share your projects and get help
3. **Submit Issues** → Report bugs and suggest features
4. **Create Pull Requests** → Contribute code improvements
5. **Write Tutorials** → Help others learn AG-UI






📅 Community Events:

- **Monthly Meetups** → Virtual presentations and demos
- **Hackathons** → Build cool projects with AG-UI
- **Conferences** → AG-UI talks at major tech events
- **Workshops** → Hands-on learning sessions



Congratulations!

You've completed the comprehensive AG-UI tutorial! You now have the knowledge and skills to:

-  Build interactive AI agents with modern frontend frameworks
-  Implement real-time streaming and state synchronization
-  Create custom UI components generated by AI
-  Handle complex multi-agent workflows
-  Deploy production-ready AG-UI applications



Your Next Steps:

1. Build your first real-world AG-UI project
2. Share it with the community
3. Contribute back to the ecosystem
4. Help others learn AG-UI



Remember: The best way to master AG-UI is to build something awesome with it. Start small, iterate quickly, and don't be afraid to experiment!



Tutorial Metrics



Learning Outcomes Achieved:

- ☐ Understanding of AG-UI protocol fundamentals
- ☐ Hands-on experience with multiple implementation patterns
- ☐ Knowledge of production deployment strategies
- ☐ Familiarity with the AG-UI ecosystem



Time Investment:

- **Quick Start:** 25 minutes
- **Deep Dive:** 90 minutes
- **Explorer Mode:** 2-4 hours
- **Total Mastery:** 6-8 hours



Success Metrics:



- Built a working AI agent interface

- Implemented interactive UI components
- Understanding of event-driven architecture
- Confidence to build production applications

*This tutorial is maintained by **Raphaël MANSUY** and based on verified information from official sources including the [AG-UI Protocol Repository](#), [Official Documentation](#), and [CopilotKit](#). Found an issue? [Contact Raphaël](#) | Want to contribute improvements? [Connect on LinkedIn](#)*

 **Last Updated:** June 29, 2025 | **Version:** 1.0.0 | **Status:** Expert Verified 




Sources Verified

- **AG-UI Protocol Repository:** 4.5k+ , actively maintained (verified June 28, 2025)
- **Official Documentation:** <https://docs.ag-ui.com> (verified)
- **CopilotKit Integration:** 21.6k+ , primary frontend framework (verified)
- **A2A Protocol:** [Google's Agent2Agent Protocol](#) (official, 50+ partners, verified)
- **MCP Protocol:** [Anthropic's Model Context Protocol](#) (official, verified)
- **Community Examples:** Live demos and working integrations (verified)
- **Framework Support:** [LangGraph](#), [CrewAI Crews](#), [CrewAI Flows](#), [Mastra](#), [AG2](#), [Agno](#), [LlamaIndex](#) (all verified)
- **Event Types:** 22+ official event types from TypeScript/Python SDKs (verified)

Agent Framework Resources

Supported Frameworks & Official Links:

-  **LangGraph** → Multi-agent orchestration framework
 - [Documentation](#)
 - [CopilotKit CoAgents](#)
 - [Examples](#)
-  **CrewAI** → Collaborative AI agent teams
 - [CrewAI Documentation](#)
 - [CrewAI Crews Guide](#)
 - [CrewAI Flows Guide](#)
 - [AG-UI Integration](#)
-  **Mastra** → TypeScript-first agent framework
 - [Mastra Documentation](#)

- [AG-UI Integration Guide](#)
- [GitHub Repository](#)
-  **AG2** → Open-source AgentOS
 - [AG2 Documentation](#)
 - [GitHub Repository](#)
 - [AG-UI Integration](#)
-  **Agno** → Multi-agent system orchestration
 - [Agno Documentation](#)
 - [GitHub Repository](#)
 - [Examples](#)
-  **LlamaIndex** → RAG and knowledge integration
 - [LlamaIndex Documentation](#)
 - [GitHub Repository](#)
 - [AG-UI RAG Examples](#)

Ready to Transform Your Business with AI Agents?

This tutorial just scratched the surface of what's possible with AG-UI and modern AI agent architectures.

If you've made it this far, you understand the transformative potential of AI agents in frontend applications. But moving from tutorial to production-ready, business-critical AI systems requires deep expertise, strategic thinking, and proven methodologies.

Get Expert AI Agent Consulting from Raphaël

As the author of this comprehensive guide and an AI/ML architect currently driving large-scale AI adoption at **DECATHLON** through **Capgemini Invent/Quantmetry**, I help organizations transform their ideas into production-ready AI agent systems.

What makes this different:

- **Real-world experience** building enterprise AI agents at scale
- **Deep technical expertise** across all major AI frameworks (LangGraph, CrewAI, Mastra, AG2)
- **Strategic guidance** on AI architecture, not just implementation
- **Proven methodologies** for organizational AI transformation

How I Can Help Your Organization

AI Agent Strategy & Architecture

- Assess your current AI readiness and identify high-impact opportunities
- Design scalable multi-agent systems for your specific use cases
- Create technical roadmaps for AI adoption across your organization

Implementation & Development

- Build production-ready AI agents using AG-UI and modern frameworks
- Implement secure, scalable agent orchestration systems
- Integrate AI agents seamlessly into your existing tech stack

Organizational AI Transformation

- Guide leadership through AI adoption strategies
- Train your development teams on modern AI patterns
- Establish best practices for AI governance and ethics

Perfect For:

- **Startups** looking to integrate AI agents as a core differentiator
- **Enterprise teams** scaling AI beyond proof-of-concepts
- **Product managers** defining AI-powered product strategies
- **CTOs** establishing AI architecture standards

Start Your AI Agent Journey

Ready to discuss your AI agent project? Let's explore how we can transform your ideas into production systems.

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 **Current Focus:** AI/ML initiatives with DECATHLON • Investor at [QuantaLogic](#) & [Student Central AI](#)

From tutorial to transformation. Let's build the future of AI agents together.

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